
Department of Genetics

Febr. 23, 1959

Dr. Richard Davies
Jet Propulsion Laboratories
California Institute of Technology
Pasadena 4, California

Dear Dick:

A propos the Cytherian atmosphere, some useful figures are in Hutchinson's chapter in THE EARTH AS A PLANET. Fossil carbon adds up to 18 kg/cm^2 ; atmospheric CO_2 is 460 mg/cm^2, for a ratio of about 40,000:1. Hess reports the Cytherian atmosphere as being about 500X richer in CO_2 than ours. I am not clear whether this can be a measurement of the total atmospheric content, or only that part above the cloud mass. The terrestrial atmosphere contains about 1:3000 CO_2 ; the Cytherian atmosphere would have to have a substantial component at 10 atm. or higher pressure for it to contain an amount of CO_2 equivalent to the total carbonate sedimented on earth. Perhaps it does.

The biosphere may contain 1 - 10 g/cm^2 (i.e. total organic C) of which perhaps 1-10 pc. is 'living'. This would be roughly comparable to atmospheric CO_2 on earth, and considerably less than Venus by this estimate. In any case, I don't see how one can draw any particular inferences. The biosphere is only a small part of the total carbon, and whether the rest is locked away as carbonate sediments or as atmospheric CO_2 seems to me to depend more directly on other factors than the metabolism of the biosphere. (I should have stressed that 'fossil' carbon includes 2-3X as much carbonate as reduced carbon).

Still on Venus, you might do us a great service for the next meeting if you could get someone to give us a more critical appraisal of the temperature profile. Is the 200° estimate highly plausible, and does it necessarily apply to the surface or to some layer perhaps just beneath the clouds, or above them for that matter? Hess has an oblique comment about possible 'electric' rather than thermal activation of the emitting layer-- what does that mean? If you could get someone to review what the earth would look like from Venus by inference from the same methods, we might have a better perspective.

I expect you walked off, inadvertently, with my potential diagram-- unhappily that is my only copy. I am sure that this does not represent a minimum-energy path for a collision, and possibly not even for soft landing. The line integral you're thinking of would apply to a conservative system, but I'm adding up the |absolute| values for each step, since the rocket has to do work equally to accelerate or decelerate. The paths I've pictured would be: (a) from earth's surface to solar orbit at 1 A.U. (= escape from earth's field), (b) circular orbit at 1 A.U. to circular orbit at 1.52 A.U. (= co-orbital with Mars and at equal velocity (c) work to decelerate in Mars" field (= escape from Mars). A grazing orbit, i.e., ellipse with aphelion at 1.52 A.U. would reduce (b) to about half, and if the velocities were in the right sense, (c) might also be partly reduced. I haven't worked this out carefully, and would be grateful if one of your experts could reduce the results to the simple graphical form indicated. This may not be terribly important any more, but it would be interested to see at a glance what the energy cost of various missions was.